I, the undersigned, who have prepared English translation which is attached herewith, hereby declare that the aforementioned translation is true and correct translation of officially certified copy of the Korean Patent Application No. 2000-66757 filed on November 10, 2000.

This 12th day of September, 2005

Translator: ______________________
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(Translation)

APPLICATION FOR PATENT

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TITLE OF INVENTION: LCD FOR SPEEDING INITIAL BEND STATE, DRIVER AND METHOD THEREOF

Submitted herewith is/are an application identified above pursuant to Article 42 of the Patent Act.

This 10th day of November, 2000

Patent Attorneys: Won-Kun KIM

To the Commissioner of
the Korean Industrial Property Office

Attachment: 1. Abstract, specification(and drawing)-one copy each

KOREAN INDUSTRIAL PROPERTY OFFICE

This is to certify that the following application annexed hereto is a true copy from the records of the Korean Industrial Property Office.

Application Number: Patent Application No. 2000-66757

Date of Application: November 10, 2000

Applicant(s): Samsung Electronics Co., Ltd.(LCD Business)

COMMISSIONER

[ABSTRACT OF THE DISCLOSURE]

[ABSTRACT]

The present invention is directed to a liquid crystal display device and a method for driving the same for a fast transition into a bend state at initial operation such as immediately after power is inputted in a liquid display device with an OCB mode. According to one feature of the present invention, as power is inputted, a timing controller (i) controls to output at least one of a gate voltage for a scan signal, a data voltage for a picture signal, and a driving voltage for a backlight by outputting a first switching signal to a switching unit, and (ii) controls to output one of an external bias voltage and a common electrode voltage by outputting a second switching signal to the switching unit so that fast transition into bend state of liquid crystal arranged in a LCD panel is accomplished. As a result, by applying a voltage of less level than that of the typical common electrode voltage to the LCD panel, as DC voltage of at least 10 volt to 20 volt is applicable to a common electrode, time for transition into bend state can be reduced at initial operation of the liquid crystal display device using the LCD panel with OCB mode.

[REPRESENTATIVE FIGURE]

Fig. 3

[KEY WORDS]

Liquid crystal display, LCD, OCB, bend state, high-speed

[SPECIFICATION]

[TITLE OF THE INVENTION]

LCD FOR SPEEDING INITIAL BEND STATE, DRIVER AND METHOD THEREOF

[BRIEF DESCRIPTION OF THE DRAWINGS]

Fig. 1 shows a view for illustrating operation of a typical OCB mode.

Fig. 2 shows a view for illustrating ON/OFF cycle of the typical OCB mode.

Fig. 3 shows a view for illustrating a liquid crystal display device for fast transition into bend state according to an embodiment of the present invention.

Fig. 4 shows a waveform for illustrating signals shown in Fig. 3.

Fig. 5 shows a view for illustrating an example of an external bias voltage according to the present invention.

<Explanations of marks of Drawings>

100: timing controller	200: gate driver
300: data driver	400: DC-DC converter
500: switching unit	600: LCD panel
700: inverter	800: backlight

[DETAILED DESCRIPTION OF THE INVENTION]

[OBJECT OF THE INVENTION]

[FIELD OF THE INVENTION AND CONVENTIONAL ART IN THE FIELD]

The present invention relates generally to a liquid crystal display device and a method and apparatus for driving the same, and more particularly to a liquid crystal display device and a method for driving the same for fast transition into bend state at initial operation such as immediately after power is inputted in a liquid display device with an OCB mode.

In general, as a liquid crystal display device is even thinner and lighter and consumes less power than a cathode ray tube (CRT) dominated up to now in the field of display device, now it is widely used as a display device in potable information apparatuses such as a mobile telephone and a notebook computer. In addition, as it has a weak emission of electromagnetic wave, it is also expected to be a mainstream in a display device for desktop in preference to the CRT in the future.

However, such a liquid crystal display device has a disadvantage in that a view angle property by which brightness and color change depending on a viewing direction is poor. Various approaches for addressing the disadvantage have been suggested.

For example, an approach for improving straightforwardness of light incoming from a backlight by use of a prism attached to a surface of a light plate so that brightness in a vertical direction is increased by more than 30 % has been put to practical use and an approach for increasing a view angle by use of a negative light compensation plate is in application.

In addition, though an In Plane Switching mode has been developed to accomplish a wide view angle of 140° of about the same level as CRT, this mode needs further improvement due to its relative low aperture ratio.

Besides, many attempts have been made to increase the view angle, including approaches such as an OCB (Optical Compensated Birefringency) mode, a PDLC (Polymer Dispersed Liquid Crystal) mode, a DHF (Deformed Helix Ferroelectric) driven by TFTs.

Particularly, the OCB mode is now under lively development because of its high speed of response and its wide view angle.

Now, operation of the above OCB mode will be described with reference to Fig. 1.

Fig. 1 shows a view for illustrating operation of a typical OCB mode and Fig. 2 shows a view for ON/OFF cycle of the OCB mode.

Referring to Fig. 1, an initial alignment state of liquid crystal positioned between an upper electrode and a lower electrode is Homogenous state (referred to "H" state hereinafter). At that time, when a predetermined level of voltage is applied to the upper/lower electrodes, "H" state is transferred into Bend state (referred to "B" state hereinafter) via Transient splay (referred to "T" state hereinafter) and Asymmetric splay (referred to "A" state hereinafter) to operate as the OCB mode.

As shown in Fig. 1, a liquid crystal cell in the OCB mode is prepared by rubbing alignment films in same direction, with a pretilt angle in the vicinity of alignment films of about 10° – 20° and a cell thickness of 1.5 – 2.5μm. As orientation of liquid crystal molecules in the middle of liquid crystal layer becomes symmetric, a tilt angle becomes 0° below a specified voltage and 90° above the specified voltage.

In the above OCB mode, though it takes several seconds to change the tilt angle of the middle liquid crystal molecules from 0° to 90°, back-flow is not present for a variation of voltage after that and a response time is very short to be in order of 10 ms because of the bend state of the liquid crystal layer and a large modulus of elasticity.

As shown in Fig. 2a, for ON state of the typical OCB mode, though a conversion from "T" state to "A" state is fast and a conversion from "T" state to "B" state is relatively fast, a conversion from "A" state to "B" state is slow. As also shown in Fig. 2b, for OFF state of the typical OCB mode, though a conversion from "B" state to "H" state is slow, a conversion from "T" state to "H" state or from "A" state to "H" state is fast.

As is described above, the problems are present that it takes several seconds to obtain bend state for the OCB mode and, particularly, the liquid crystal of OCB mode can be worked only when bend state transition is induced through an entire liquid crystal panel by applying a high voltage during a short period after a power switch of a PC monitor or a TV turns on.

[TECHNICAL TASK OF THE INVENTION]

In considerations of the above problems, it is an object of the present invention to provide a liquid crystal display device for fast transition into bend state at initial operation such as immediately after power is inputted in a liquid crystal display device with an OCB mode.

It is another object of the present invention to provide an apparatus for driving a liquid crystal display device for fast transition into bend state at initial operation such as immediately after power is inputted in a liquid crystal display device with an OCB mode.

It is still another object of the present invention to provide a method for driving a liquid crystal display device for fast transition into bend state at initial operation of a liquid crystal display device with an OCB mode.

[CONFIGURATION AND OPERATION OF THE INVENTION]

To achieve these objects, according to an aspect of the present invention, a liquid crystal display device comprises,

a timing controller for outputting a first switching signal the backlight control signal of OFF state at initial operation and outputting a second switching signal and the backlight control signal of ON state after a predetermined period elapses;

a DC-DC converter for outputting a predetermined bias voltage; and

a switching unit for outputting the bias voltage as the bias signal when the first switching signal is applied by the timing controller and the common electrode voltage as bias signal when the second switching signal is applied by the timing controller

a backlight unit for outputting light according to the application of the backlight driving voltage;

a gate driver for outputting a scan signal;

a source driver for a picture signal; and

an LCD panel including a plurality of gate line for transmitting the scan signal, a plurality of source line intersecting the plurality of gate lines for transmitting the image signal, a plurality of switching element connected to the plurality of gate line and source line, respectively, and a plurality of picture electrode connected to the plurality of switching element for responding operation of the plurality of switching element, arranged in a matrix type, wherein fast transition into a bend state is induced by an application of the bias voltage at initial operation.

Preferably, the timing controller applies the backlight control signal of OFF state to the second direct current power conversion unit at the initial operation, and applies backlight control signal of ON state to the first direct current power conversion unit at the point that transition into bend state of liquid crystal arranged in the LCD panel is completed when a predetermined period elapses.

Preferably, the bias voltage is a voltage of less level than the common electrode voltage.

Preferably, the bias voltage is one of -10 volt and –20 volt.

Preferably, the timing controller outputs an alternatively selected one of the first switching signal and the second switching signal when the backlight control signal of OFF state is applied.

To achieve these objects, according to an aspect of the present invention, a liquid crystal display device comprises a plurality of gate line for transmitting the scan signal, a plurality of source line intersecting the plurality of gate lines for transmitting the image signal, a plurality of switching element connected to the plurality of gate line and source line, respectively, and a plurality of picture electrode connected to the plurality of switching element for responding operation of the plurality of switching element, arranged in a matrix type, and backlight unit,

wherein further comprising:

a timing controller for outputting a first switching signal the backlight control signal of OFF state at initial operation and outputting a second switching signal and the backlight control signal of ON state after a predetermined period elapses;

a DC-DC converter for outputting a predetermined bias voltage; and

a switching unit for outputting the bias voltage as the bias signal when the first switching signal is applied by the timing controller and the common electrode voltage as bias signal when the second switching signal is applied by the timing controller

a gate driver for outputting a scan signal;

a source driver for a picture signal.

Preferably, the timing controller applies the backlight control signal of OFF state to the second direct current power conversion unit at the initial operation, and applies backlight control signal of ON state to the first direct current power conversion unit at the point that transition into bend state of liquid crystal arranged in the LCD panel is completed when a predetermined period elapses.

Preferably, the bias voltage is a voltage of less level than the common electrode voltage.

Preferably, the bias voltage is one of -10 volt and –20 volt.

Preferably, the timing controller outputs an alternatively selected one of the first switching signal and the second switching signal when the backlight control signal of OFF state is applied.

According to still another aspect of the present invention, a driving method of a liquid crystal display device including a LCD module including a LCD panel, a gate driver, and a data driver; and a backlight positioned at a back side of the LCD panel, comprising:

(a) a step of inducing transition into bend state by a high voltage by applying a data voltage and a gate voltage not selected at initial operation of the liquid crystal display device to the LCD panel and applying an external bias voltage separately to the LCD panel;

(b) a step of interrupting the external bias voltage when a predetermined time elapses and applying a common electrode voltage to the LCD panel; and

(c) a step of applying a predetermined backlight driving voltage to the backlight at the same time of applying the common electrode voltage to the LCD panel.

Preferably, the step (a) further comprises a step of selecting alternatively the external bias voltage and the common electrode voltage several times and applying a

selected one of the external bias voltage and the common electrode voltage to the LCD panel.

Preferably, the point that the predetermined time elapses in the step (c) is the point that transition into bend state is completed.

Preferably, the step (a) includes applying the backlight driving voltage of OFF state to the backlight upon applying the external bias voltage separately to the LCD panel.

Preferred embodiment of the present invention will now be described in detail with reference to the accompanying drawings.

Fig. 3 shows a view for illustrating a liquid crystal display device for fast transition into bend state according to an embodiment of the present invention.

Referring to Fig. 3, a liquid crystal display device for fast transition into bend state according to an embodiment of the present invention includes a timing controller 100, a gate driver 200, a data driver 300, a DC-DC converter 400, a switching unit 500, an LCD panel 600, an inverter 700, and a backlight 800.

In general, powers required for each circuit block within an LCD module are produced by increasing or decreasing a voltage from a single power supply irrespective of a kind of display device, and a kind of power supply for each circuit block within the LCD module includes the DC-DC converter 400 and the inverter 700 for driving the backlight.

In the embodiment of the present invention, the DC-DC converter 400 outputs a predetermined bias voltage, which level may be less or more level than that of a common electrode voltage (for example -10V or -20V) applied to the LCD panel 600, to the switching unit 500.

The switching unit 500 selects one of a common electrode voltage Vcom applied to the LCD panel 600 and a bias voltage outputted from the DC-DC converter 400, based on a bias voltage control signal provided by the timing controller 100, to output a selected one to the LCD panel 600.

The LCD panel 600 consists of a plurality of pixel electrode formed in an m x n matrix type. When gate voltages G1, G2, ..., Gn provided by the gate driver 200 are applied to relevant pixels, the relevant pixels are driven responsive to data voltages D1, D2, ..., Dm provided by the data driver 300. At that point, as a high voltage is applied initially to liquid crystal molecules of OCB mode inside the LCD panel 600, tilt angle of liquid crystal molecules in the middle of liquid crystal layer becomes 90° rapidly.

The inverter 700 applies a predetermined voltage for driving the backlight 800 positioned at the back side of the LCD panel 600 based on a backlight control signal applied by the timing controller 700. Typically, the inverter 700 for driving the backlight is a separate module mounted with components such as chopper and transformer and coupled to the LCD module in the entire system.

The timing controller 100 outputs data voltage and gate voltage not selected to the data driver 300 and the gate driver 200, respectively, and controls the switching unit 500 to provide the bias voltage provided by the DC-DC converter 400 to the LCD panel 600. At that point, the external bias voltage selected by the switching unit 500 is applied to the LCD panel to increase the speed of transition into bend state.

In addition, the timing controller 100 provides the backlight control signal B/L CONTROL for driving the backlight 800 for the inverter 700 when a predetermined time being an estimated time required for transition into bend state elapses and controls the switching unit 500 to provide the common electrode voltage Vcom to the LCD panel 600.

As described above, time for transition into bend state can be shortened by turning ON/OFF several times the common electrode voltage applied to the LCD panel at initial operation of the liquid crystal display device with OCB mode, and particularly can be more shortened by applying the external bias voltage of less level than the common electrode voltage.

Now, operation for driving a liquid crystal display device for fast transition into bend state according to an embodiment of the present invention will be hereinafter described in detail.

Fig. 4 shows a waveform for illustrating signals shown in Fig. 3.

Referring to Figs. 3 and 4, when a vertical synchronization signal Vsync and a horizontal synchronization signal Hsync are applied to the timing controller 100 so that the liquid crystal display device starts up, the timing controller 100 applies the backlight control signal B/L CONTROL of OFF level to the inverter 700 for driving the backlight 800 during a predetermined time (1 second in the embodiment of the present invention) such that the backlight is not driven and, when the predetermined time elapses, applies the backlight control signal B/L CONTROL of ON level to the inverter 700 such that the backlight is driven.

In addition, the timing controller 100 applies a bias control signal BIAS CONTROL for controlling switching operation of the switching unit 500. During the

predetermined time (1 second in the embodiment of the present invention), a pulse voltage, i.e., bias control signal BIAS CONTROL of ON level for selecting periodically the external bias voltage and the common electrode voltage Vcom is applied to the switching unit 500 and, when the predetermined time elapses, the bias control signal of OFF level is applied to the switching unit 500.

In other words, in the state that transition into bend state is not completed, the backlight control signal of OFF level is applied to the inverter 700 such that the operation of backlight is interrupted and simultaneously a low level of common electrode voltage and a high level of external bias voltage are applied to the LCD panel 600 in a switching manner for increasing speed of transition into bend state and, in the state that transition into bend state has completed, the backlight control signal is applied to the inverter for controlling driving of the backlight positioned at the back side of the LCD panel.

Fig. 5 shows a view for illustrating an example of an external bias voltage according to the present invention.

As shown in Fig. 5, the external bias voltage is a voltage of less level than that of the typical common electrode voltage Vcom applied to the LCD panel, as illustrated with one example in Fig. 5.

In this manner, by applying the common electrode voltage with a level lower than a typical level to the common electrode in order to accomplish fast transition into bend state at initial operation of the liquid crystal display device using the LCD panel with the OCB mode, as DC voltage of at least 10 volt to 20 volt is applicable between the common electrode and pixel electrodes, time for transition into bend state can be reduced at initial operation of the liquid crystal display device using the LCD panel with OCB mode.

In the embodiment of the present invention described above, as the magnitude of voltage applied to pixels is proportional to the speed of transition into bend state, though a level of voltage applied to the LCD panel is exemplified by –10 volt and –20 volt, it is not intended to be limited to that.

Although preferred embodiment of the present invention have been described in detail hereinabove, it should be clearly understood that many variations and/or modifications of the basic inventive concepts herein taught which may appear to those skilled in the present art will still fall within the spirit and scope of the present invention, as defined in the appended claims.

[ADVANTAGE OF THE INVENTION]

As is apparent from the above description, according to present invention, as fast transition into bend state can be achieved at initial operation of the liquid crystal display device using the LCD panel with OCB mode, time by which a user stands until a normal screen is presented in a monitor or TV using a liquid crystal display device as a display device can be reduced.

In addition, as an external bias voltage of less level than a typical common electrode voltage is simply used as a common electrode voltage at initial operation of LCD panel with OCB mode, a high voltage driver IC does not need to be adapted for applying data voltage of higher level than a fixed common electrode voltage in order to obtain fast transition into bend state and, accordingly, a liquid crystal display device can be driven at a low expense.

[CLAIMS]

1. A liquid crystal display device comprising:

a timing controller for outputting a first switching signal the backlight control signal of OFF state at initial operation and outputting a second switching signal and the backlight control signal of ON state after a predetermined period elapses;

a DC-DC converter for outputting a predetermined bias voltage; and

a switching unit for outputting the bias voltage as the bias signal when the first switching signal is applied by the timing controller and the common electrode voltage as bias signal when the second switching signal is applied by the timing controller

a backlight unit for outputting light according to the application of the backlight driving voltage;

a gate driver for outputting a scan signal;

a source driver for a picture signal; and

an LCD panel including a plurality of gate line for transmitting the scan signal, a plurality of source line intersecting the plurality of gate lines for transmitting the image signal, a plurality of switching element connected to the plurality of gate line and source line, respectively, and a plurality of picture electrode connected to the plurality of switching element for responding operation of the plurality of switching element, arranged in a matrix type, wherein fast transition into a bend state is induced by an application of the bias voltage at initial operation.

2. The liquid crystal display device of claim 1, wherein the timing controller applies the backlight control signal of OFF state to the second direct current power conversion unit at the initial operation, and applies backlight control signal of ON state to the first direct current power conversion unit at the point that transition into bend state of liquid crystal arranged in the LCD panel is completed when a predetermined period elapses.

3. The liquid crystal display device of claim 1, wherein the bias voltage is a voltage of less level than the common electrode voltage.

4. The liquid crystal display device of claim 2, wherein the bias voltage is one of -10 volt and –20 volt.

5. The liquid crystal display device of claim 1, wherein the timing controller outputs an alternatively selected one of the first switching signal and the second switching signal when the backlight control signal of OFF state is applied.

6. A liquid crystal display device including a plurality of gate line for transmitting the scan signal, a plurality of source line intersecting the plurality of gate lines for transmitting the image signal, a plurality of switching element connected to the plurality of gate line and source line, respectively, and a plurality of picture electrode connected to the plurality of switching element for responding operation of the plurality of switching element, arranged in a matrix type, and backlight unit,

wherein further comprising:

a timing controller for outputting a first switching signal the backlight control signal of OFF state at initial operation and outputting a second switching signal and the backlight control signal of ON state after a predetermined period elapses;

a DC-DC converter for outputting a predetermined bias voltage; and

a switching unit for outputting the bias voltage as the bias signal when the first switching signal is applied by the timing controller and the common electrode voltage as bias signal when the second switching signal is applied by the timing controller

a gate driver for outputting a scan signal;

a source driver for a picture signal.

7. The liquid crystal display device of claim 1, wherein the timing controller applies the backlight control signal of OFF state to the second direct current power conversion unit at the initial operation, and applies backlight control signal of ON state to the first direct current power conversion unit at the point that transition into bend state of liquid crystal arranged in the LCD panel is completed when a predetermined period elapses.

8. The liquid crystal display device of claim 1, wherein the bias voltage is a voltage of less level than the common electrode voltage.

9. The liquid crystal display device of claim 1, wherein the bias voltage is one of -10 volt and –20 volt.

10. The liquid crystal display device of claim 1, wherein the timing controller outputs an alternatively selected one of the first switching signal and the second switching signal when the backlight control signal of OFF state is applied.

11. A driving method of a liquid crystal display device including a LCD module including a LCD panel, a gate driver, and a data driver; and a backlight positioned at a back side of the LCD panel, comprising:

(a) a step of inducing transition into bend state by a high voltage by applying a data voltage and a gate voltage not selected at initial operation of the liquid crystal

display device to the LCD panel and applying an external bias voltage separately to the LCD panel;

(b) a step of interrupting the external bias voltage when a predetermined time elapses and applying a common electrode voltage to the LCD panel; and

(c) a step of applying a predetermined backlight driving voltage to the backlight at the same time of applying the common electrode voltage to the LCD panel.

12. The driving method of claim 11, wherein the step (a) further comprises a step of selecting alternatively the external bias voltage and the common electrode voltage several times and applying a selected one of the external bias voltage and the common electrode voltage to the LCD panel.

13. The driving method of claim 11, wherein the point that the predetermined time elapses in the step (c) is the point that transition into bend state is completed.

14. The driving method of claim 11, wherein the step (a) includes applying the backlight driving voltage of OFF state to the backlight upon applying the external bias voltage separately to the LCD panel.

FIG. 1

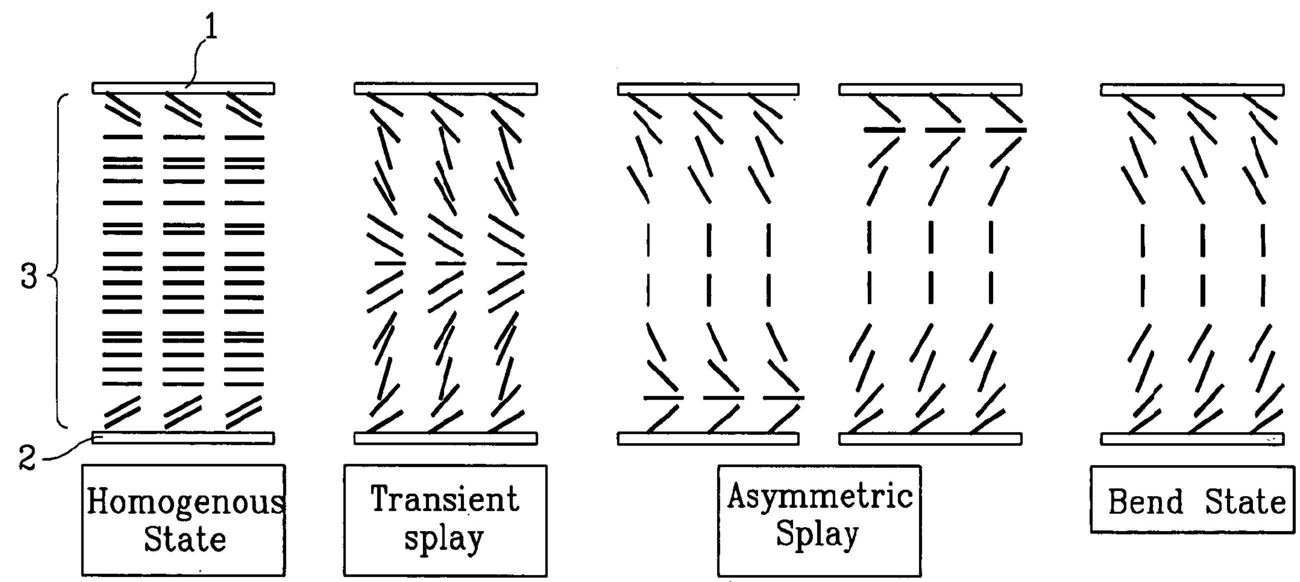

1
2
3
Homogenous State
Transient splay
Asymmetric Splay
Bend State

FIG. 2

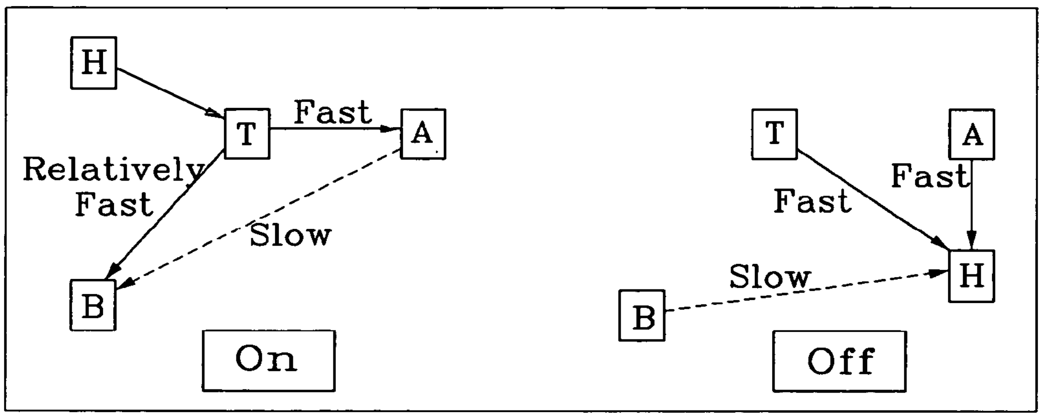
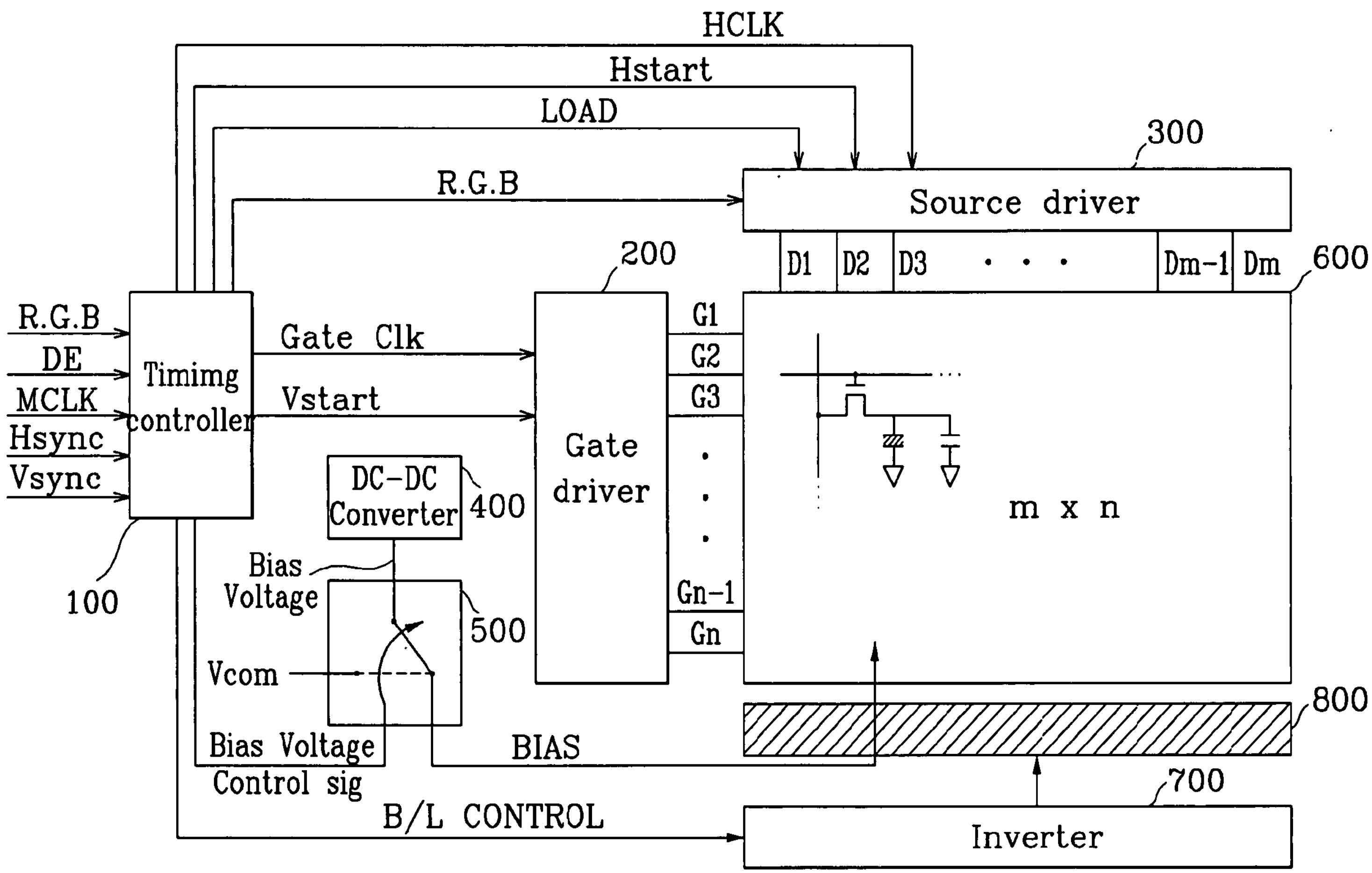


FIG. 3



HCLK
Hstart
LOAD
R.G.B
300
Source driver
D1
D2
D3
Dm-1
Dm
600
200
R.G.B
DE
MCLK
Hsync
Vsync
Timimg controller
Gate Clk
Vstart
Gate driver
G1
G2
G3
Gn-1
Gn
m x n
DC-DC Converter
400
Bias Voltage
500
Vcom
100
Bias Voltage Control sig
BIAS
800
700
B/L CONTROL
Inverter

FIG. 4

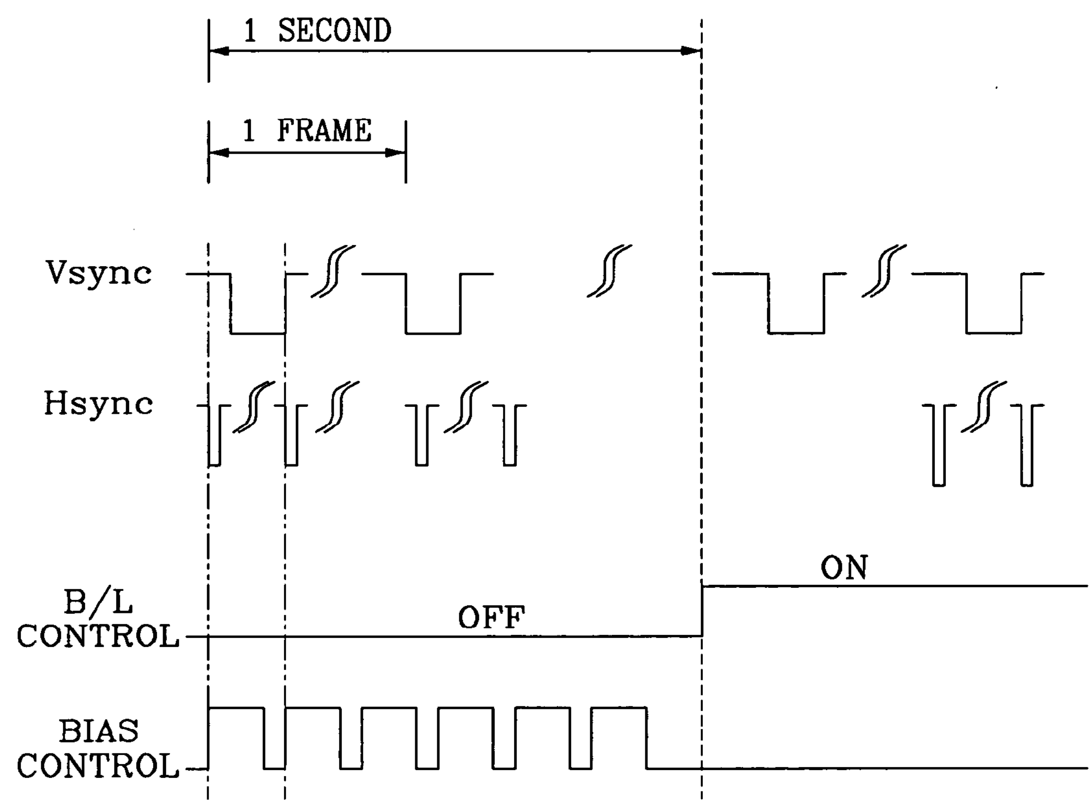
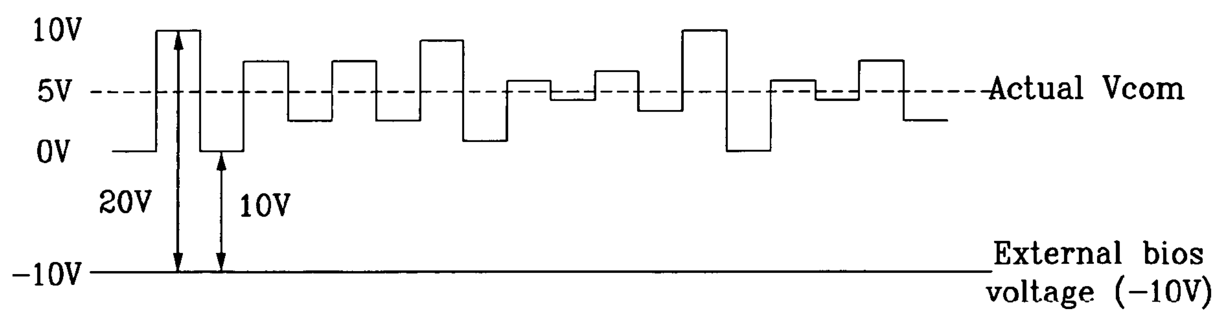

1 SECOND
1 FRAME
Vsync
Hsync
B/L
CONTROL
OFF
ON
BIAS
CONTROL

FIG. 5


10V
5V
0V
20V
10V
-10V
Actual Vcom
External bios
voltage (-10V)